Key Considerations from Primer

The program must play an essential role to report on this measure. An essential role is one that would be described by stakeholders and partners as essential for the project's ultimate success.

When a program has a non-essential role, describe the project's impacts or accomplishments in narrative form for the annual report but do not include these the performance measures and metrics.

- Not everything needs a number
- Count what you can count
- Sometimes a story is best
- If it's too complicated, report it as an Impact or Accomplishment
- Do not seek out nor shy away from large numbers. Larger benefits are ok but should be reviewed with added rigor
- Do not use multipliers
- Include citations in reporting to enhance clarity, defensibility, and transparency.

Damage Reduction from Coastal Flooding

Sea Grant programs conduct a range of activities to reduce potential physical damages to homes and infrastructure in vulnerable parts of communities across the country. Typically, these Sea Grant activities are relatively prescriptive actions intended to protect a certain vulnerable area in a community against a specific environmental threat or hazard event. This guide presents a method to monetize the benefits (primarily avoided losses) for certain Sea Grant adaptation strategies and policies that protect buildings and infrastructure. This type of analysis generally requires geographic information system (GIS[1]) expertise and takes more than a few hours to implement. While this guide addresses infrastructure damage reduction, if your activity can also help a community's Federal Emergency Management Agency (FEMA) Community Rating System score, see the FEMA Community Rating System guide. Below, we discuss the difference between adaptation strategies that will be relatively easier to value (might take a few days for a reasonable estimate) and adaptation strategies that will be relatively harder to value (might take months, extensive resources, and economic expertise).

- **Easier-to-value adaptation strategies:** These strategies generally generate a distinct binary change. That is, the strategy wholly does or does not achieve its intended goal. For example, elevating homes or critical infrastructure above a certain level of flooding would wholly move the structures out of harm's way. If the homes or critical infrastructure were not elevated above a certain level of flooding, those structures would definitely flood. Other examples of easier-to-value adaptation strategies include but are not limited to retreat policies that move houses out of harm's way, policies that prevent future building in flood-prone locations, and green or gray infrastructure that prevent flooding to a certain water level (e.g., sea walls, dune restoration, beach nourishment). In these cases, we can reasonably assume we are preventing all damage up to that design standard.[2]

  For these easier-to-value strategies, you could use any of the three methods presented in the "Recommended Methodology and Best Practices" section, depending on data availability, resources, and desired level of effort.

- **Harder-to-value adaptation strategies:** These strategies typically generate an incremental or partial change in infrastructure protection. That is, the strategy can improve infrastructure protection and reduce damages but does not wholly avoid damages. For example, strategies (e.g., mangroves, living shorelines, oyster reefs) that help protect communities by lessening but not eliminating the extent of flooding (e.g., by reducing wave action) often require resource-intensive engineering estimates to calculate the degree to which they provide flood protection. This is an added challenge of estimating benefits associated with projects that do not wholly protect up to a certain flood level. This guide provides a method to calculate the estimated value of damage for buildings that measures protect, but it does not capture how to estimate the degree to which these types of strategies offset those damages.

1 See the "Tools for Implementation" section of this guide for a link to free ESRI ArcGIS training modules. Additionally, academic institutions often have ESRI GIS licenses that programs can look into using and/or free ESRI student-level GIS licenses that might be useful if a Sea Grant program wants to use graduate students or interns, scholarships, or fellowships to conduct GIS work.

2 This binary approach assumes that gray and green infrastructure are implemented and appropriately maintained over time. In the case of dune restoration, this means a long-term beach management strategy to address the system's sustainability.

This guide is not meant for estimating the benefits for these harder-to-value strategies; instead, these methods focus on evaluating impacts from stillwater flooding (i.e., a bathtub model). You could implement Method 2 or Method 3 (presented below) to calculate the value of land or buildings at risk of being lost to sea level rise and flooding (which is helpful context for an impact statement), but you could not calculate the benefit of the adaptation strategy because of the uncertainty in how much these harder-to-value strategies would offset the loss. We recommend you develop a well-crafted impact statement to qualitatively convey the strategy's important economic value if this is the case.

- **Data needs for future valuation of harder-to-value strategies:** In addition to the data needs we present in this guide for easier-to-value strategies, the option for future valuation hinges on reports and data that quantify the effectiveness of harder-to-value strategies. For example, if studies showed a certain percent reduction in flooding or storm surge levels that the Sea Grant activity or intervention provided to the community, neighborhood, property, or municipality, the studies could help quantify how many losses could be avoided. However, these types of studies are limited for several reasons—including geography, engineering solution, habitat, etc.—and often cannot be defensibly transferred to your projects at the time of this guide.

What You Can and Cannot Do with This Guide

This methodology guide will help you value adaptation strategies that generate a binary change (easier-to-value strategies), as we will generally assume all damage is reduced to a certain point (e.g., flood level or design standard) and infrastructure is wholly protected or out of harm's way.

We do not present a method to value adaptation strategies that generate incremental or partial protection changes (harder-to-value strategies), as this is a complex process that involves economists, hydrologists (hydrodynamic modelers), geologists, and extensive financial resources. **However, we do discuss the data needs** for potentially measuring the value of harder-to-value adaptation strategies, such as reducing flooding by lessening wave action.

Examples

Here are two modified examples of activities to reduce damages associated with sea level rise or coastal flooding, loosely based on those submitted to Sea Grant's Planning, Implementation, and Evaluation Resources (PIER)[3] database. Additionally, the value chain section that follows provides a third example. For each example, we provide our thoughts on what the Sea Grant program did well and what could be improved.

Planning, Policy, Coordination, Building Codes, and Regulatory Activities

1 Sea Grant helped a municipality make regulatory decisions to develop new building ordinances to lessen the impacts from sea level rise and coastal flooding on newly constructed homes and infrastructure. To date, this activity preserved six lots where new construction would have been constructed in a vulnerable area as open space. Sea Grant thus prevented the construction of about $3 million worth of property that coastal flooding and/or sea level rise would likely damage.

✔ Sea Grant documented its role well and made a strong case for how it wholly prevented construction in an area vulnerable to flooding.

✘ This story would have been more defensible if Sea Grant cited the source (e.g., from the county assessor's database or a real estate website like Zillow.com) from which the estimated value of the prevented future construction, within the zoning for that area, was taken.

3 Sea Grant programs use PIER to submit their impacts, accomplishments, performance measures, and metrics to the National Sea Grant Office.

Project Implementation

2 A Sea Grant program played an essential role in coordinating funding for a dune restoration project. Before the project, relatively small storms were, according to business owners, causing at least $250,000 of flood damage each year to businesses behind the now-restored dunes. The estimated lifespan of the dunes is approximately five years before additional work might be necessary, providing an estimated benefit of at least $1.25 million ($250,000 [flood damage to businesses each year] x 5 years [lifespan of restored dunes]) over the lifetime of the project with potentially much higher savings, as these dunes may also protect against larger, more damaging storms.

✅ Sea Grant clearly presented the historical baseline for annual damage. Sea Grant documented its role and clearly explained how its actions would result in avoided costs for the businesses.

❎ This story would have been more compelling if Sea Grant described how information from business owners was obtained (e.g., interviews, insurance claims, public reports). This benefit estimation should incorporate a discount rate for benefits in future years (this will not dramatically impact the final result). See Method 1, step 3, in the "Recommended Methodology and Best Practices" section for an example of how to do this.

Present Your Story as a Value Chain

Value chains illustrate the sequence of events or activities that result in an economic impact or benefit. Consider developing a value chain diagram to help you tell a compelling and defensible story about how your Sea Grant program, product, or service generated a measurable result.

Let's use an example to illustrate how to create a value chain.

Sea Grant staff consulted with and provided information ***[the program/product/service]*** *to a homeowner who was concerned about their home* ***[what was affected]*** *because it had been marked as a high-risk property for impacts from storm surge and sea level rise. After consulting with Sea Grant staff, the homeowner decided to move their house* ***[what was done to get the impact]*** *back on their property out of the area that sea level rise and high tide would have inundated by 2050, according to the local university's sea level rise model estimates* ***[measurable change]****. Not moving the house would have resulted in a complete loss in 10 years due to flooding from storm surge and sea level rise. The house, now protected from damages from projected storm surges and sea level rise, is worth $2.4 million according to Zillow.com; thus, the benefit of these actions is $2.4 million* ***[societal benefit]****.*

Recommended Methodology and Best Practices

This is a modified version of the guide NOAA published to determine the benefits of projects that adapt to sea level rise and coastal flooding events: What Will Adaptation Cost? An Economic Framework for Coastal Community Infrastructure. The methods outlined below range from relatively lower levels of effort (Methods 1 and 2) to relatively higher levels of effort (Method 3). As part of Method 3, we recommend the potential use of COAST (the Coastal Adaptation to Sea Level Rise Tool) to estimate damages from sea level rise and flood events (although one could also use FEMA's HAZUS tool for this analysis). See the "Working with COAST" and "Tools for Implementation" sections for more information.

Key Steps and Best Practices

Below, we outline three methods to estimate the benefits of damage reduction. All three methods assume your project generates a distinct binary change, completely preventing damages up to a certain standard (e.g., it protects up until 4 feet above mean-higher-high water [MHHW]).

- Method 1 allows for a simpler, back-of-the envelope calculation for projects that prevent nuisance flooding ***when you have historical data about those losses***.
- Method 2 allows you to calculate the benefits of projects that protect against sea level rise because they would prevent a total loss. This is a simpler method (than Method 3) and only estimates the losses prevented over time from sea level rise. It does not consider additional damage from storm surge (so it is a conservative, underestimate of the total benefit).
- Method 3 involves GIS expertise and modeling using COAST or FEMA's HAZUS and will help you calculate the projected benefits of projects that prevent damage from the combined impact of sea level rise (if desired) and larger storms (e.g., a 100-year storm).

For each method, we suggest nationally available tools and data. However, programs might find they have knowledge of and access to more relevant local tools and data that get updated over time. In these cases, feel free to use and cite the locally sourced tools and data, so long as they are comparable substitutes for the national tools and data.

Method 1: Estimate damage reduction from adapting to recurring flooding (lower level of effort but specific applicability).

Estimate the avoided loss from a Sea Grant project that prevents recurring damage. With some additional data to determine the lifetime of the project, the home retreat example in the "Present Your Story as a Value Chain" section is a reasonable example of when to implement this back-of-the-envelope method.

Criteria: Damage or business interruption is occurring through smaller, recurring events; Sea Grant activity eliminates losses from these types of flooding events in the future.

Data needs: Approximate annual losses (damage and/or business interruption) over about three to five years. This should exclude damage from major events, such as hurricanes, and primarily reflect flooding that recurs each year, based on historical flood data.

Steps:

1. **Develop a baseline for losses that your project would have prevented.** Estimate the annual damage to buildings and infrastructure and/or business losses. If possible, use average data from a few years before the project. Exclude losses from any large events, as these may not represent an annual average. Exclude any losses from flood events that your project would not have prevented.
   - **Example:** Let's assume that conducting a dune restoration project would prevent $200,000 worth of damages ("B" in the formula presented in Table 1) to coastal infrastructure per year.
2. **Determine the lifetime of your project.** This is how long you can defensibly and conservatively assume your project will be effective.
   - **Example:** Let's assume that a dune restoration project would prevent the coastal infrastructure from incurring annual losses, and that the lifetime of the dune restoration project ("n" in the formula presented in Table 1) is five years.
3. **Calculate the present value of the benefit.** Table 1 provides an example of how you could set up this calculation in Microsoft Excel or Google Sheets. Calculate the present value using the lifetime of your project (from step 2), the baseline annual losses you prevent (from step 1), and a discount rate. See the "Tools for Implementation" section of this guide for information on submitting present value of benefits to PIER.
   - **Example:** Many entities select discount rates by approximating what the annual rate of return could have been if they invested the money elsewhere.[4] For example, if a municipality would have invested their money in a municipal bond with a 3 percent interest rate, use a 3 percent discount rate.

   a. Copy and paste the contents in Table 1 into Microsoft Excel or Google Sheets to create your own discount rate calculator. The present value of the example carried through the above steps ($200,000/year in prevented damages, five-year project lifetime, 3 percent [.03] discount rate) is $915,942.30.

Present Value: Present value is a calculation that measures the worth of a future amount of money in terms of "today's dollars."

For more information on **Present Value**, see the "Sea Grant Economics 101" document.

Table 1. Excel Discount Rate Calculator Template

	A	B	C
1	**Description (cell A1)**	**Value/Formula (cell B1)**	**Notes**
2	Life of project (n)	5 (cell B2)	Example Value
3	Discount rate (i)	3% (cell B3)	Example Value (enter 3% as 0.03)
4	Damage prevented (B)	$200,000 (cell B4)	Example Value
5	Present value of benefit	$915,942 (cell B5)	Example Calculation
6	Formula	=PV(B3,B2,-B4,-1)	Formula (copy/paste into cell B5)

4 A discount rate is used to adjust the future value of something—in this case, a damage reduction project—to today's dollars. 3 percent is a commonly used discount rate in regulatory impact analyses and climate change-related analyses.

Method 2: Estimate damage reduction from adapting to sea level rise plus high tide (medium level of effort but specific applicability).

Estimate avoided damage to buildings or infrastructure as a result of Sea Grant projects that prevent flooding from sea level rise plus high tide within the lifetime of the project. If sea level rise plus storms larger than high tide will flood your buildings or infrastructure, consider Method 3. Examples for Method 2 could include a project that protects certain buildings or infrastructure from sea level rise plus high tide or policies that move or prevent building in areas impacted by sea level rise plus high tide. Programs might consider investing resources to implement this method if the project reflects state, local, or program priorities, as this valuation typically yields robust and defensible estimates.

Criteria: Buildings or infrastructure that will be flooded by sea level rise plus high tides within the lifetime of the Sea Grant project.

Data needs: Sea level rise projections (for longer-term projects), high tide above MHHW, value of infrastructure or buildings that sea level rise and high tide would inundate, and lifetime of Sea Grant project. The steps below include recommendations for reliable data sources

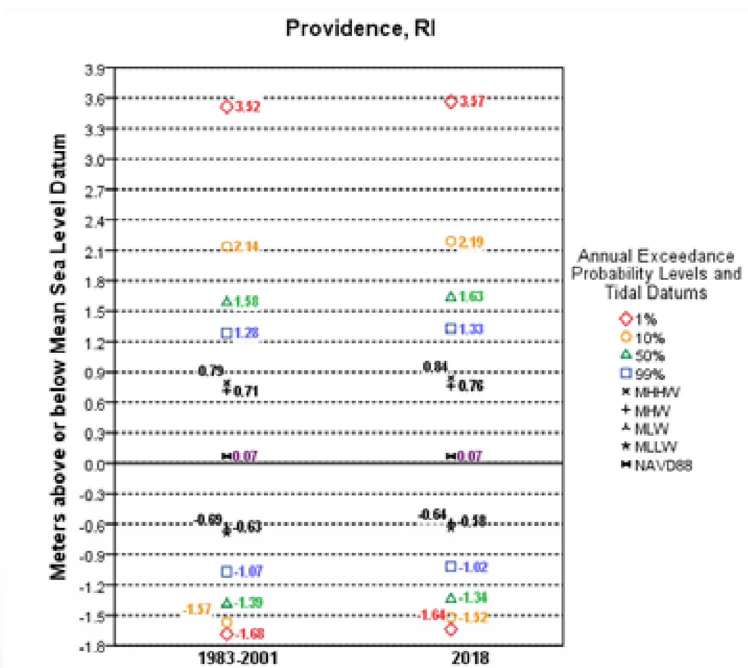
Steps:

1. Determine the value of buildings and infrastructure in harm's way that you are protecting. This could be the value of houses from a real estate website (e.g., the Z-estimate in Zillow, or the estimates in Redfin, Realtor.com, or Trulia) or the assessed value of homes and offices from a county or municipal assessor's property tax database, or it could be the cost to build infrastructure like roads that are both within an area that would be exposed to sea level rise and high tide and protected by your project.

   a. Determine a reasonable sea level rise estimate that goes through the end of your project's lifetime. The NOAA Sea Level Rise Viewer shows estimated sea level rise by location, year, and scenario (extreme, high, medium, low). We recommend using a "medium" scenario as a conservative starting point; be sure to note that you used the medium scenario when you write up the results.

   b. Determine the height of likely annual flood events (99 percent probability of happening in a given year). Go to the NOAA Extreme Water Levels webpage, select the location closest to your project, click "Exceedance Probability Levels," and then find the figure similar to Figure 1 below to determine the height of the 99 percent probability. In Figure 1, the 99 percent probability is 0.49 meters above MHHW (i.e., 1.33 - 0.84) and 1.26 meters above NAVD88[5]. You can use this tool to determine the height of high probability events relative to several reference points.

Figure 1. Exceedance probability levels example for Providence, Rhode Island.



5 The North American Vertical Datum of 1988 (NAVD88) is the official vertical datum in the National Spatial Reference System for the Conterminous United States and Alaska. https://www.ngs.noaa.gov/datums/vertical/north-american-vertical-datum-1988.shtml

c. Sum together sea level rise and the 99 percent recurrence interval (in this example, 0.49 meters) to determine the height of frequent flooding in future years. (This will show a flood that will almost always occur each year in the future after accounting for sea level rise.)

2. Assume that the benefit is everything that your project protects within these flooded areas.

Method 3: Estimate avoided damage from sea level rise plus storms (higher level of effort [GIS expertise needed] with broadest applicability).

Estimate avoided damage to buildings or infrastructure as a result of Sea Grant projects that prevent flooding from sea level rise plus any level of coastal storms within the lifetime of the project. Examples could include a project that protects certain buildings or infrastructure from sea level rise plus a 100-year storm (1 percent probability of occurring annually). Programs might consider investing resources to implement this method if the project reflects state, local, or program priorities, as this valuation typically yields robust and defensible estimates.

Criteria: Generally, it would be best to determine whether you intend to use COAST at the beginning of a project to ensure you collect the necessary data along the way. Projects intended to protect buildings and/or infrastructure that are at risk of flooding due to sea level rise plus larger storms might justify investment in this higher level of effort.

Data needs: Sea level rise projections (for longer-term projects), height of water above MHHW from a number of storms (e.g., 1 percent, 10 percent, 50 percent, and 99 percent annual exceedance probability), county or municipal assessor's office parcel data with building values for what you are protecting, and a digital elevation model from NOAA or another credible source like the U.S. Geological Survey.

Before you start: Review the "Working with COAST" section of this document to determine which tool (COAST or HAZUS) is best for your program. The method below uses COAST to assess the value of buildings at risk (exposed/vulnerability) and to estimate average annual damage (which is needed to properly estimate the benefit). If you decide to use HAZUS, ensure your program understands the time commitment to become familiar with HAZUS and refer to the HAZUS Flood User Guidance document.

Steps:

1. Download COAST.
2. Get sea level rise data (see step 1a of Method 2).
3. Get exceedance probability data for storm surge events (see step 1b of Method 2).
4. Get a shape file of parcel value data and upload it to COAST (File >> Load Data). You will likely need to get these data from a municipal or county assessor's office.
5. Get a digital elevation model and upload it to COAST (File >> Load Data). NOAA has a website to access digital elevation models.
6. Create a COAST model parameters file (COAST >> Create Model Parameters File) and perform the following:

   a. Add the exceedance probability data from step 2 to the "Exceedance Curves" tab. ***Note: if you are trying to calculate a benefit from your project that protects only to a certain standard, ONLY include combined water levels up to the height that you have protected a community.*** That is, if you've protected up to sea level rise plus a 50 percent annual probability exceedance, do not include large storms (10 percent annual exceedance and 1 percent annual exceedance). For example, if your project protects to 5 feet above MHHW, only include storms from the annual exceedance probability levels that are at or below 5 feet above MHHW (from step 3). If you're just curious about overall damage from sea level rise and storm surge (and are not calculating a benefit for PIER or other economic benefits reporting), include all exceedance values.

   b. Add your selected sea level rise scenarios at certain years to the "Sea Level Rise" tab.

   c. Set your base "water level above NAVD88" on the "Base Water Levels" tab. The base water level should be the reference point you obtained for the height of the storm surge events in step 3. For example, if you select MHHW as your reference point, you can input this value as the difference between MHHW and NAVD88 in the exceedance probability levels you found in step 3.

7 Run the storm damage model (COAST >> Run Model Scenario >> Estimate Cumulative Storm Damage) and perform the following:

a. Name your scenario.

b. Add a “new asset.”

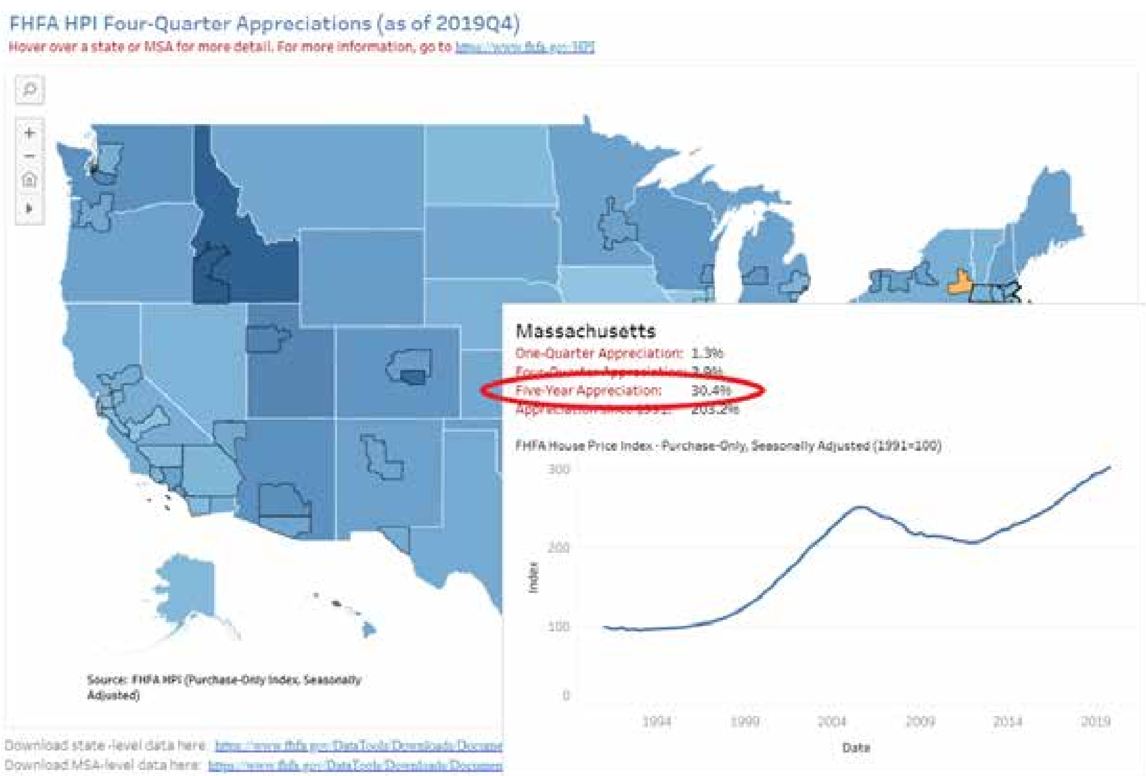
i. Use the default “Army Corps Residential w/Basement” depth-damage curve for simplicity. This default depth-damage curve estimates the proportion of damage to a parcel.

ii. Select the field in your parcel value that includes the building value.

iii. Use the [Federal Housing Finance Agency (FHFA)] webpage to approximate housing appreciation. To do this:

1. Go to the [FHFA webpage].
2. Use your mouse to hover over or click on your state. Select the “Five-Year Appreciation” value. As shown in Figure 2, this value for Massachusetts is 30.4 percent.
3. Annualize this “Five-Year Appreciation” value by dividing the number identified above by 5. For example: 30.4 percent / 5 = 6.08 percent.
4. Use 6.08 percent as the annual housing appreciation value.

Figure 2. Screenshot of the FHFA webpage used to determine housing appreciation.



c. Select a discount rate (see Method 1, step 3, for context).

d. Click “consider an asset abandoned or adapted when it is flooded due to SLR only.”

e. Enter the start and end years of your analysis.

f. Enter an output location for your run.

8 Calculate the total loss of the parcels in your model. This will either be the estimated cumulative loss or the benefit that your project provides, depending on how you input exceedance curves in step 6a.

Working with COAST

Methods 1 and 2 are grounded in information needed to conduct a complete damage assessment, while Method 3 is a complete damage assessment. You should only use COAST in Method 3. In Method 3, we indicate that COAST can add value with its ability to easily and visually create vulnerability assessments (i.e., estimate the value of potentially exposed buildings and land).

Vulnerability assessments: In the COAST vulnerability assessment, we focus on exposure. For example, if a $500,000 home is flooded by 1 foot of water, the vulnerability or exposure value is $500,000. This exposure value is powerful when telling a story about vulnerability, but it is not a benefit of avoiding the 1 foot of flooding. The exposure value does not represent the damages or loss as a result of the flooding, which is the economic benefit. COAST can help programs convey what is vulnerable or at stake if communities take no action by communicating exposure values as impact assessments. This type of information might be especially useful when programs do not have the data or resources to model damage reduction. Programs can use COAST to conduct vulnerability assessments and to easily visualize the vulnerable geographic area and the exposure value associated with that area.

Damage assessments: COAST allows users to assess damages or losses given available data and resources (HAZUS also has this capability). For example, if a $500,000 home is flooded by sea level rise, we have a $500,000 loss (damage) because sea level rise would permanently impact the home. If the $500,000 home was flooded by 1 foot of water from a one-time hazard event, the loss would be some portion—perhaps $150,000—of the home's value. To the degree that we can prevent these losses, the economic benefit would be $500,000 for the sea level rise example and $150,000 for the one-time hazard event example. All three methods outlined in this document are based on damage assessments.

In general, you would use **COAST** (which is much faster to download and easier to learn than HAZUS) if you:

- **Have geolocated parcel value data**, work within a **geographic area at the city level or below**, and are less interested in roads and critical infrastructure.
- Want to see **damage at the parcel level** (Hazus only shows overall losses down to the Census block level).
- Need to incorporate **both sea level rise and storm surge**. COAST handles this much better and clearly differentiates sea level rise inundation from event-based flooding.

HAZUS is much more challenging to work with and is designed to model flood losses, not permanent losses from sea level rise inundation. Therefore, using HAZUS' loss estimates would underestimate total losses. Generally, you would use **HAZUS** if you:

- Do not have **geolocated parcel value data**, as HAZUS has some assumptions built in (COAST requires geolocated parcel value data as an input).
- Need losses for roads or other critical infrastructure, as these values are not typically part of the geolocated parcel value data.
- Work with **geographic areas** that are substantially larger than the city level.

HAZUS also has earthquake, wind, and tsunami modules that programs could use to assess damages or losses given available data and resources. These additional modules require a relatively high level of effort and will necessitate multiple days (possibly weeks) of program staff training. Finally, even after staff spend time working with these additional modules, expert assistance might still be necessary, as they are generally intended for expert use and not as an "off-the-shelf" product.

Factors to Consider in Communicating Benefits

<table>
<tr><th></th><th>Performance Measure Reporting in PIER</th><th>Impact Statements and Other Outreach</th></tr>
<tr><td>Recurring Impacts</td><td colspan="2">Most projects are designed to have long lifetimes/provide protection for more than one year and sometimes many years. For example, a project that protects against sea level rise may not see major benefits for many years, as sea level rise increases. Thus, we recommend you calculate the present value of the benefit for the lifetime of the project and report that value a single time in PIER or for other outreach, regardless of whether the lifetime of your project is five years or 50 years.</td></tr>
<tr><td>Attribution</td><td>Avoid double counting when multiple Sea Grant programs are involved. Multiply the final $value by the fraction of your level of effort (LOE) divided by total Sea Grant LOE (e.g., you provided 400 hours, Sea Grant program 2 provided 600 hours, and another organization provided 500 hours). Multiply the final $value by 40 percent (i.e., your 400 hours / 1,000 total Sea Grant hours [600 + 400]). The other Sea Grant program will multiply by 60 percent. Together, the two Sea Grant programs are now claiming they were essential contributors to the full $value (without double counting). Note, the Sea Grant programs are claiming they were an essential contributor to the full value, but not the only contributors to this full value. You can apply this method to the fraction of the LOE that your program used for the damage reduction project.</td><td>There is generally no need to attribute the value of your contribution; simply state you played an essential role in a project that provided $X in savings to participants and ensure your role is transparent and well described to tell an effective story. If you need to attribute your LOE for outreach, use your percent LOE as a rough estimate (e.g., Sea Grant contributed 300 hours out of a total 1,000 hours, so it contributed 30 percent).</td></tr>
<tr><td>Very Large Impacts</td><td colspan="2">Very large impacts are likely for many analyses, particularly policies that will prevent future development in certain areas or projects that protect highly valued housing or infrastructure. It might be worthwhile to have an economist quickly review any projected benefits that are greater than $1 million.</td></tr>
</table>

Tools for Implementation

The table below presents more information about the methods and tools we recommend using as part of this analysis. For the relative level of effort designations below, low level of effort indicates that a non-economist committed to the valuation and having some background knowledge of the topic area could use the tool. High level of effort indicates that an individual needs specialized expertise and training to use the tool.

Method/Tool	Outputs	Relative Level of Effort	When to Use
What Will Adaptation Cost? An Economic Framework for Coastal Community Infrastructure **(Framework)**	Cost-benefit analysis of adaptation	Medium/High	This method might be useful for program activities specifically designed to make infrastructure more resilient to sea level rise and storm surge events.
NOAA Sea Level Rise Viewer **(Tool)**	Inundation from sea level rise or total water levels	Low	This tool is useful to visually see maps of inundation from total water levels or sea level rise. It also provides the local sea level rise estimates by year, scenario, and location.

COAST **(Tool)**	Damage from sea level rise and flooding	Medium/High	COAST is an ArcGIS-based technical tool that allows users to visualize areas of flood concern, estimate damage dollar amounts, and estimate costs to protect areas given a specified design standard. This tool can be used to determine a portion of the costs and benefits of various intervention methods (e.g., seawall, levee, building or relocation ordinances). See the "Working with COAST" section of this document.
HAZUS **(Tool)**	Damage and business losses from flooding	High	Hazus is a technical tool that models infrastructure damages and business losses from flooding and several other hazard events (e.g., earthquakes, tsunamis, hurricanes, wind events). Hazus runs in tandem with ArcGIS, so ArcGIS experience is required. See the "Working with COAST" section of this document.
Free ESRI ArcGIS Training Courses **(Tool)**	Foundation of understanding and familiarity using ArcGIS	Medium (can be time-consuming depending on level of existing experience)	These free ESRI ArcGIS trainings can be used as an introduction to, or a way to brush up on, using ArcGIS, which is needed for this guide.